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(54) Orthopaedic brace having a range of motion hinge with an adjustable-length strut

(57) An orthopaedic brace includes a strut length adjustment assembly to change the operable length of the strut for sizing the brace on a patient without the need for special tools or cutting of the strut. The adjustment assembly includes a biassed adjustment mechanism that coacts with a plurality of notches in the strut to variably set/position the strut relative to the adjustment assembly to set the struts length. Each upper and lower strut preferably includes a strut length adjustment assembly to independently set the length of each strut. The strut length adjustment assembly retains a strut and includes a strap retention mechanism that is configured to releasably engage the strap.

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Description

[0001] The present application relates to orthopaedic braces adapted with an adjustable-length strut for use in stabilizing a joint after invasive surgery.

[0002] In order to ensure the proper healing of a human joint after an injury or invasive surgery, it is often desirable to limit the pivotal motion of the human joint to a predetermined angular range between full extension and full flexion. The pivotal motion may be limited by a range of motion hinge disposed between an upper strut and a lower strut. In order for the orthopaedic brace to function properly, the struts must be adaptable to the body proportions of the patient.

[0003] Orthopaedic braces of this general type, including information relating to range of motion braces, and how and why such equipment is used, are disclosed in US-552143, US-649237, US-4776326, US-4817588, US-4982732, US-5052379 and US-5018514.

[0004] It is well known that the orthopaedic braces described in the aforementioned patents suffer various problems, shortcomings and disadvantages. In some cases such braces cannot be adjusted to fit the patient, rather, the braces come in various fixed sizes. Alternatively, the braces are not easily adjustable, requiring, for example, tools to change the size of the struts. Some braces require actual cutting or breaking off pieces of the struts to permanently change the length of the struts. Others which rely upon friction to fix the strut at a desired length to not lock the length of the strut positively.

[0005] The present invention is an orthopaedic brace that has adjustable length struts.

[0006] In one form, the present invention provides an orthopaedic brace including a first strut, a second strut, a hinge disposed between the first and second struts, and an adjustment assembly disposed on one of the first and second struts. The hinge is configured to allow movement of one of the first and second struts about an axis defined by the hinge. The adjustment assembly is configured to cooperate with the one of the first and second struts to adjustably set an operative length of the one of the first and second struts.

[0007] In another form, the present invention provides an orthopaedic brace including an upper strut, a lower strut, a hinge disposed between the upper strut and the lower strut, and an adjustment assembly disposed on one of the first and second struts. The hinge is configured to allow movement of one of the upper and lower struts about an axis defined by the hinge. One of the upper and lower struts has a plurality of notches defining a plurality of strut length settings. The adjustment assembly is configured to cooperate with any one of the plurality of notches of the one of the first and second struts to selectively set a length of the one of the first and second struts.

[0008] In yet another form, the present invention provides an orthopaedic brace including an upper strut, a lower strut, a hinge disposed between the upper strut and the lower strut, an upper adjustment assembly disposed on the upper strut, and a lower adjustment assembly disposed on the lower strut. The hinge is configured to allow movement of one of the upper and lower struts about an axis defined by the hinge. The upper adjustment assembly is configured to cooperate with the upper strut to adjustably set a length of the upper strut. The lower adjustment assembly is configured to cooperate with the lower strut to adjustably set a length of the lower strut.

[0009] Accordingly, the present invention improves upon the prior art by providing an orthopaedic brace strut that may be changed in length without the use of tools and with the ability to return to the original length, or some other length as desired.

[0010] The present invention also provides for a single-action positive lock for a strut length adjustment assembly rather than relying on friction. The ability to size and resize the struts provides a cost-effective and comfortable means to apply an orthopaedic brace to virtually any joint on the human body and eliminates the need to carry large inventories of braces that cannot be sized. By providing a positive lock, the improved brace also better protects the patient and speeds recovery.

[0011] The present invention also allows contoured wings, with cushioning material and/or non-slip material attached, to be used to limit movement of the brace after it has been attached and to provide increased comfort to the patient.

[0012] The present invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a side perspective view of an adjustable orthopaedic brace assembly having adjustable-length strut assemblies that embodies principles of the present invention showing the brace operatively connected to a human leg;

FIGS. 2A and 2B are, respectively, top and underside perspective views of an adjustable-length strut assembly for the orthopaedic brace of FIG. 1;

FIG. 3 is an exploded, perspective view of the adjustable-length strut assembly of FIGS. 2A and 2B;

FIG. 4 is a cross-sectional view through the adjustable-length strut assembly taken along line 4-4 of FIG. 3;

FIG. 5 is a perspective view of a second embodiment of an adjustable-length strut assembly;

FIG. 6 is a cross-sectional view through the second embodiment of the adjustable-length strut assembly taken along line 6-6 of FIG. 5;

FIG. 7 is a cross-sectional view through the second embodiment of the adjustable-length strut assembly taken along line 7-7 of FIG. 6; and

FIG. 8 is a perspective view of a third embodiment of an adjustable-length strut assembly.

[0013] In the drawings, corresponding reference characters indicate corresponding parts throughout the several views.

[0014] Referring to the drawings, Fig. 1 shows an orthopaedic brace 10 operatively attached to a leg 64 using a plurality of straps 54 mounted on an upper strut 12 and a lower strut 14 with a hinge assembly 16 disposed between the upper strut 12 and the lower strut 14. While only one side of the orthopaedic brace 10 is shown (i.e. the hinge assembly 16, the upper strut 12, and the lower strut 14 or "assembly") it should be understood that an identical, but mirror image, assembly is provided on the opposite side of the leg 64.

[0015] Each strut 12 and 14 is provided with a preferably identically configured wing assembly 18 although variations in either are contemplated, which is slidably mounted for adjustable movement on the elongated struts 12 and 14. Stated in another manner, each strut 12 and 14 is adjustable in length relative to the length of the strut between the hinge 16 and the straps 54 through adjustable strut assemblies 18. Such will be considered hereafter as the length adjustment of a strut. It should be appreciated that such assemblies 18 may be provided on both struts 12 and 14, or only on one of the two struts 12 and 14. As well, it should also be appreciated that adjustability of the length of a strut may be considered as either or both the adjustment of the assembly 18 relative to a strut (12 and/or 14), or as the adjustment of a strut (12 and/or 14) relative to the assembly 18.

[0016] The adjustable mounting of the wing assembly 18 on elongated struts 12 and 14 allows the struts to telescope or move in and out, one in opposition to the other, of the respective wing assembly 18, as will be described subsequently, to accommodate long or short legs, as one example, or long or short anus, as another example. Because the structure and function of the wing assembly is similar regardless of whether mounted to the upper strut 12 or the lower strut 14, reference will be made to only the upper strut 12 in the following description and its wing assembly 18. As well, because the structure and function of the struts 12 and 14 are identical (assuming each strut terminates in a wing assembly 18), reference to strut 12 in the following description will be construed to pertain to strut 14.

[0017] Referring to Fig. 2A, the wing assembly 18 has a wing body 20, which is preferably formed of a relatively rigid material, as for example plastic. The wing body 20 has an arcuate profile and is provided with one or more strap-retaining loops 22 for receiving the one or more adjustable straps 54 that are threaded through the loops 22 to encircle both the wing assembly 18 and a human limb, such as the leg 64 (as depicted in Fig. 1), thereby immovably securing the brace 10 to the leg 64, for example. Fig. 2B shows that the underside of the arcuate-shaped wing body 20 is provided with a generous layer of non-slip cushioning 50, both to pad the wearer's limb and to assure that the brace 10 remains in place.

[0018] Figs. 2B, 3, 4A and 4B reveal that the underside of the wing body 20 defines a unitary channel 46 that runs longitudinally down the entire length the wing body 20. While the channel 46 is generally open, splitting the cushioning 50 into two halves, a lip 48 portion of the wing body 20 overhangs the channel 46 at each of the side edges of the channel 46 down the entire longitudinal length of each side of the channel 46. The channel 46 with opposing lips 48 receives the elongated strut 12 and retains and guides the strut 12 as it telescopes in and out of the channel 46. The open nature of the channel 46 also helps to reduce the overall weight of the orthopaedic brace 10.

[0019] Referring to Figs. 2B and 3, the strut 12 has formed through its body a longitudinal slot 60. The length of the slot 60 may be varied depending upon the desired maximum and minimum lengths of the orthopaedic brace 10. Longitudinally spaced down each side of the slot 60 are a plurality of arcuate-shaped, stop notches generally designated 62. The notches 62 are equally divided into a plurality of notches 62a that are mirror images of, and directly across the slot 60 from, a plurality of opposing notches 62b, such that the opposing, arcuate-shaped pairs of notches 62a and 62b would define a circle if their ends were connected by an arc of constant radius equal to the distance from the centre of the slot 60 to the centre of the opposing notches. One end of the slot 60 contains an arcuate-shaped notch 62c and the other end of the slot 60 contains a mirror image arcuate-shaped notch 62d. Notches 62c and 62d are connected on each end to the outer ends of notches 62a and 62b. It should be appreciated that the notches may be shaped other than that shown.

[0020] Referring to Fig. 3, it can be seen that the wing body 20 also defines a depression or chamber 28 on the top of the body 20 which is shown as circular but can be any shape. The wing body 20 also defines an aperture 26 of smaller diameter than the chamber 28 that extends through the centre of the chamber 28 all the way to the slot 60 on the underside of the wing body 20. The chamber 28 and aperture 26 are adapted to house a positive-lock, adjustment or button assembly 30.

[0021] The adjustment assembly 30 (Fig. 3) has a generally flat pushbutton top 32 that has a cylindrical extension 34 extending downward away from and perpendicular to the top. The cylindrical extension 34 has a radius that allows it to freely travel through the aperture 26 and the slot 60 without engaging any of the notches 62a and 62b. With additional reference to Figs. 4a and 4b, a threaded aperture 36 extends down through the centre of the top 32 and the extension 34 and is adapted to receive a screw 42 from the underside of wing body 20. Fitting over the extension 34 is a biassing spring 38 of smaller diameter than the chamber 26. A retaining bushing 40, with a radius approximating that of the

and

the lower adjustment assembly comprising:

a lower body having a lower slot configured to slidably receive the lower strut; and
a lower retention assembly configured to engage any one of the plurality of lower notches to set the length of the lower strut.

17. A brace as claimed in claim 16, in which the upper and lower retention assemblies each include:

an actuator;
a spring;
a fastener; and
a bushing;
in which the fastener couples the bushing to the actuator with the spring disposed between the actuator and the bushing.

18. A brace as claimed in claim 17, in which the upper and lower retention assemblies are each normally biassed into engagement with a selective one of the plurality of upper and lower notches respectively by the respective springs.

19. A brace as claimed in claim 18, in which each the upper and lower retention assembly can be biassed into temporary disengagement from the selective one of the plurality of upper and lower notches respectively.

20. A brace as claimed in claim 19, in which the upper and lower bodies each further comprise a channel configured to receive a strap adapted to attach to a body part of a user.

21. An orthopaedic brace comprising:

an upper strut;
a lower strut;
a hinge disposed between the upper and lower strut; and
a wing assembly disposed on one of the upper and lower struts, the wing assembly including a strap retainer configured to releasably retain a strap for securing the wing assembly to a body part of a user.

22. A brace as claimed in claim 21, in which the strap retainer comprises a resilient member having a first end fixed to the wing assembly and a second end releasably engageable with the wing assembly.

23. A brace as claimed in claim 22, in which the second end includes a friction engagement mechanism

24. A strut retention assembly for an orthopaedic brace comprising:

a body;
a channel defined by the body and configured to receive a strut of an orthopaedic brace; and
a strap retainer disposed on the body and configured to releasably retain a strap for securing the body to a body part of a user.

25. An assembly as claimed in claim 24, in which the strap retainer comprises a flexible member having a first end fixed to the body and a second end releasably engagable with the body.

26. An assembly as claimed in claim 25, in which the second end includes a friction engagement device.

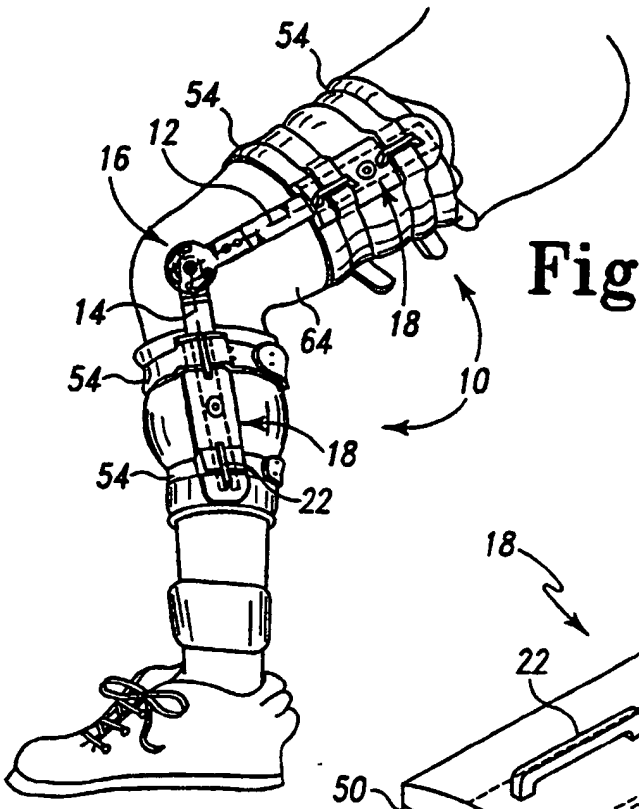


Fig. 1

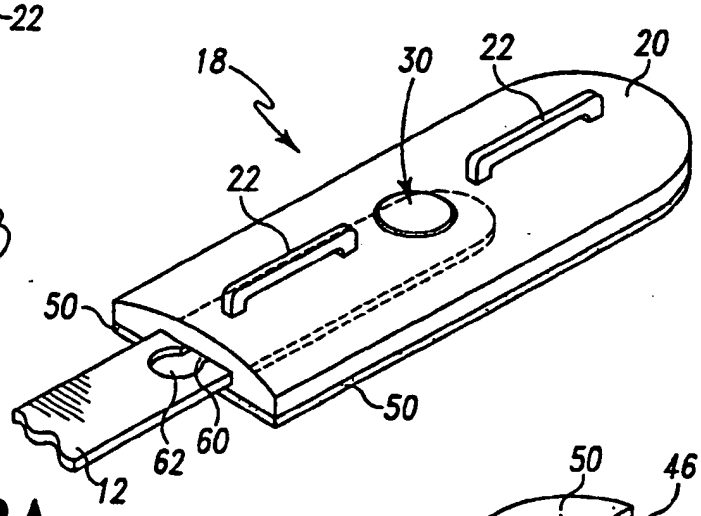


Fig. 2A

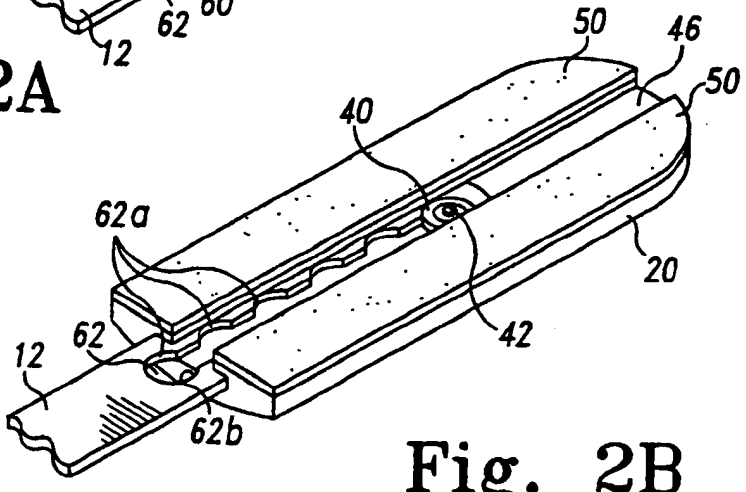
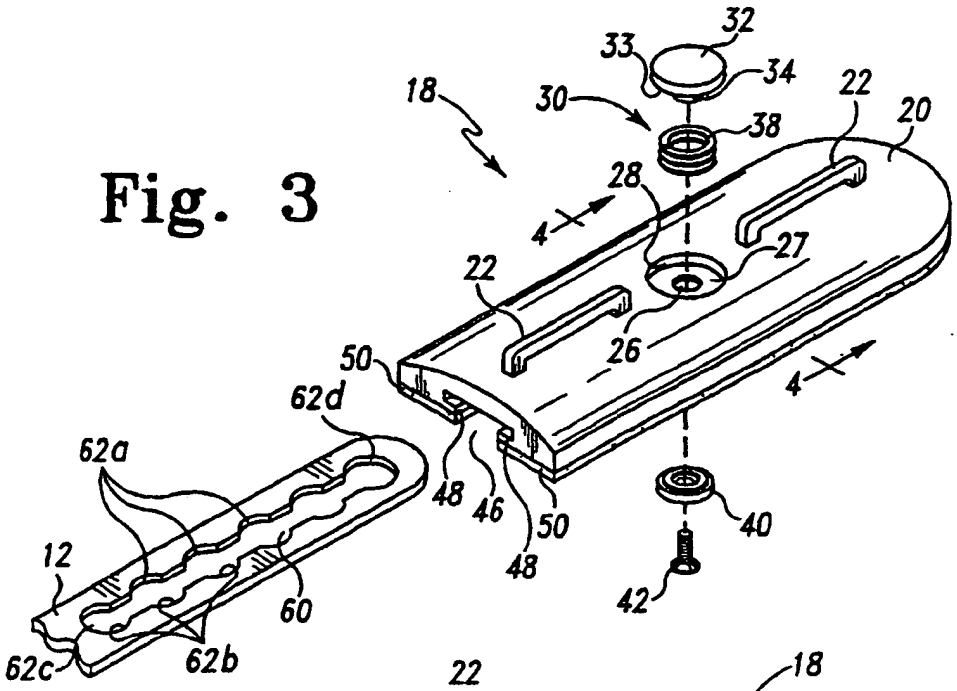


Fig. 2B

Fig. 3



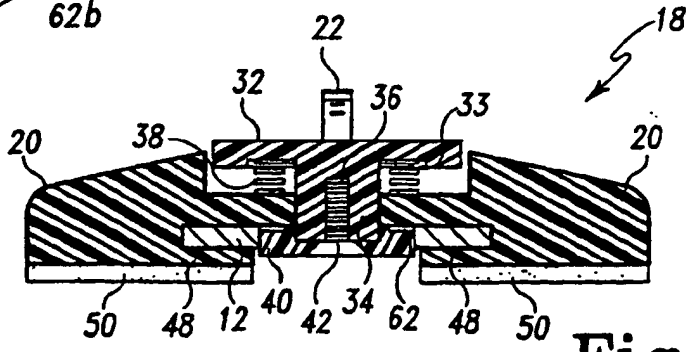


Fig. 4A

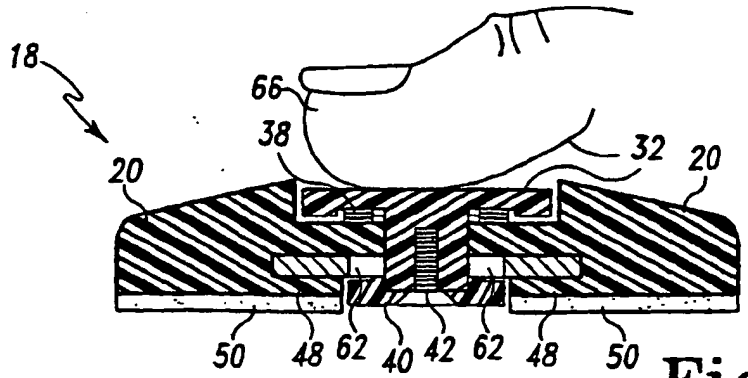


Fig. 4B

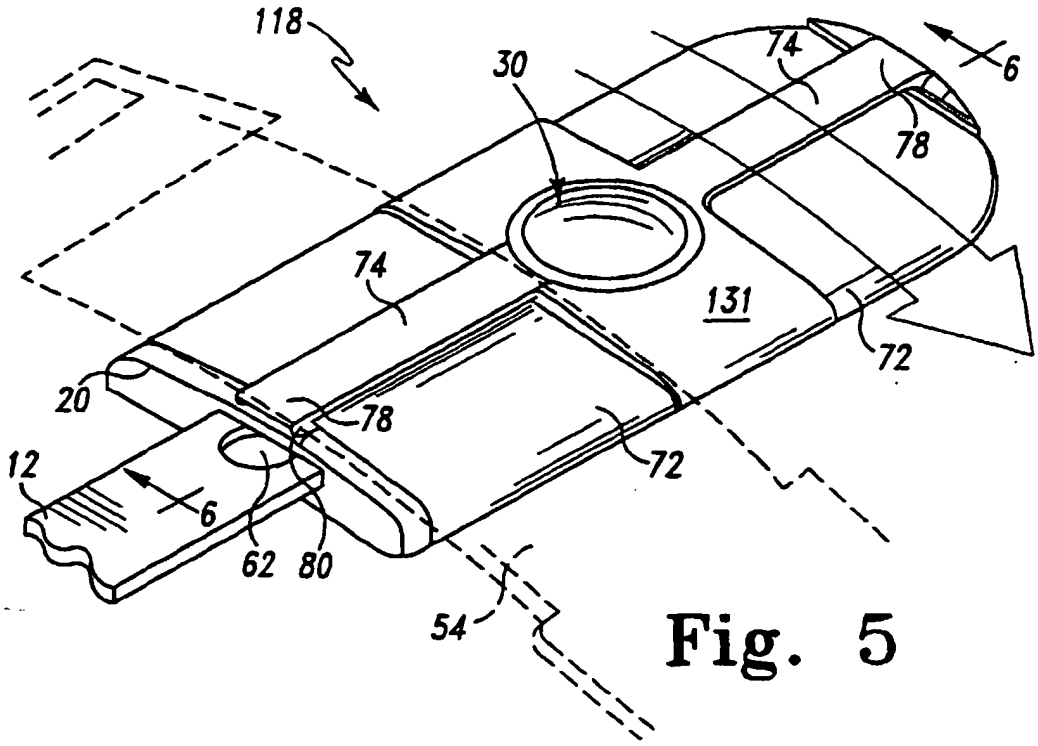


Fig. 5

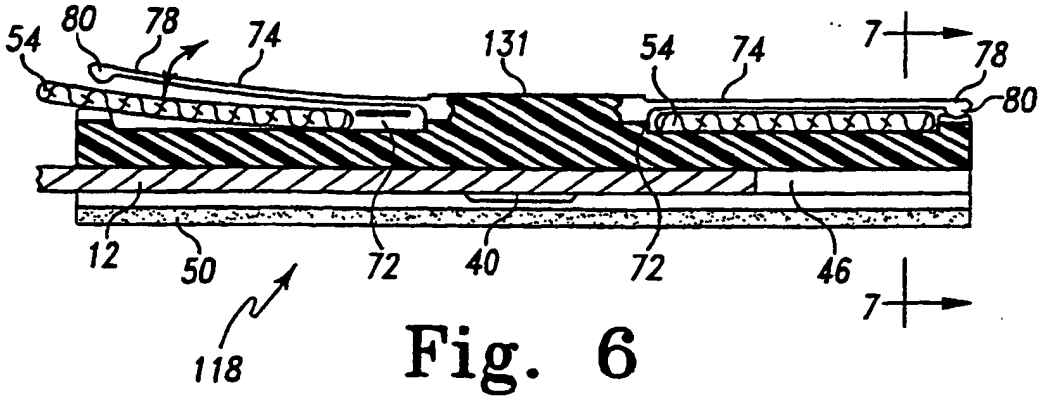


Fig. 6

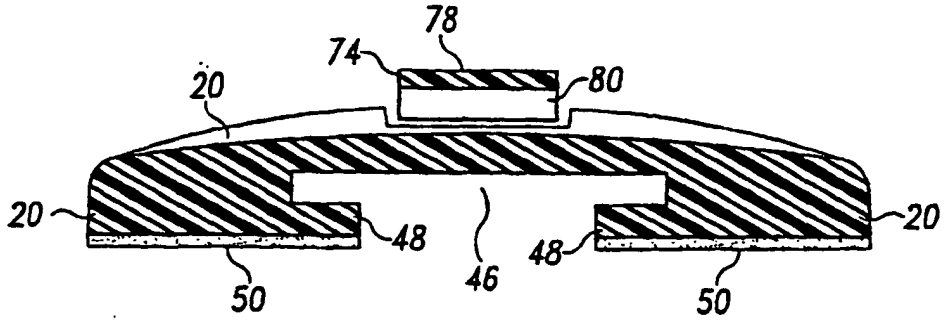


Fig. 7

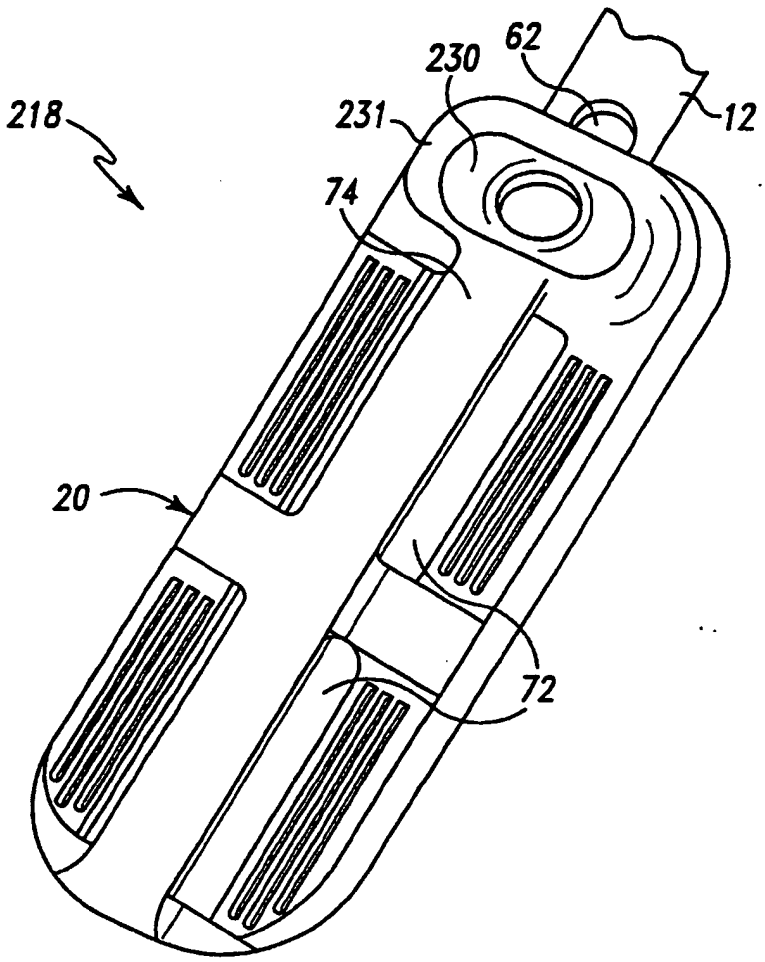


Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 5531

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X Y	US 3 805 773 A (SICHAU H) 23 April 1974 (1974-04-23) * column 6, line 20 - column 8, line 16; figure 7 *	1,2,8,9, 15,21 3-7, 10-14, 16-20, 22-26	A61F5/01 F16B7/10
Y	US 5 138 911 A (LAN WEN-RONG) 18 August 1992 (1992-08-18) * the whole document *	3-7, 10-14, 16-20, 22-26	
Y,D	US 4 982 732 A (MORRIS JOHN C) 8 January 1991 (1991-01-08) * column 4, line 53 - column 5, line 51; figures 1,2 *	1-26	
Y	EP 0 665 160 A (VALENTIN GMBH & CO GERAETEBAU) 2 August 1995 (1995-08-02) * abstract; figures *	1-26	
A,D	US 4 817 588 A (BLEDSOE GARY R) 4 April 1989 (1989-04-04)		TECHNICAL FIELDS SEARCHED (Int.Cl.7) A61F F16B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 February 2001	Sánchez y Sánchez, J

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26-02-2001

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